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ABSTRACT

The feasibility of using student cognitive attainment to determine the competence of student teachers is studied. Data on four influencs (common to all student teaching experiences) were gathered by investigating four research questions: (1) expectancies of learners held by student teachers; (2) prior solo teaching time and opportunity to learn time provided by student teachers; (3) planning and instructional effectiveness of the student teacher as perceived by the university supervisor; and (4) efficacy of explaining student cognitive attainment in terms of these three variables. The variety of instruments and scales used in obtaining measures of the dependent variables (student attainment) and independent variables (expectation of learner attainment, solo teaching time, learning time, and supervisor ratings) are described. A detailed discussion of the four regression models used to resolve the research questions is provided, accompanied by a description of the findings. In relation to question one, data did not reveal a statistically significant effect on learner attainment, while significance was indicated for questions two and three, encouraging the use of those variables in a model to explain a student's cognitive attainment. Discussion of study outcomes in relation to question four suggest that the practical significance of the model in explaining learner attainment appears to be relatively high when compared to other current research. Limitations in using the model for rating student teaching competence are enumerated. (MJB)

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Regression Models and Learner Cognitive Attainment: Means and Ends for Assessing a Student Teacher's Competence

Teacher educators and former students alike often agree that the most vital component of current teacher preparation programs is that of student teaching. Almost universally teacher preparation institutions provide their candidates with student teaching experiences, but the nature of these experiences varies substantially. Ironically, while the organization, goals, and processes of student teaching differ from program to program the assessment procedures for determining the prospective teacher's competence are usually based on classroom and university supervisor ratings. This evaluation practice is largely due to precedence, and the sheer difficulty of collecting, integrating and interpreting other sources of information to render judgements of a student teacher's competence. Conversely, our efforts have been directed primarily to determining whether it is feasible to determine the competence of the student teacher on the basis of learner cognitive attainment, assuming the supervised instructional unit being taught is appropriate for the learners.

THEORETICAL CONSIDERATIONS

A dearth of experimental research on teacher education was widely acknowledged and lamented until recently. Denemark and Macdonald (1967) described the research base in teacher education to be scanty in many areas and nonexistent in others. Since the mid-sixties, however, research interest accorded the student teaching component of teacher education has increased dramatically. The availability of teacher education candidates, the influence of TTT projects, and the difficulties encountered in gaining access to public-school classes have no doubt contributed to

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research activity in teacher education. This increased activity has produced numerous researches which can be categorized under the following headings:

(1) Affective domain investigations which include studies of anxiety levels of teaching candidates (Fuller, 1969; McMillian, 1973; Petrusich, 1967) values of student teachers (Cicirelli, 1969; Feshbach, 1969; Hartzell, Anthoney, Wain, 1973; Simon, 1967, and perceptions and behavior patterns of prospective teachers before and following student teaching (Burge, 1967; Coody, Hinley, 1967; Dumas, 1969; Wilbur, Gooding, 1977) have appeared frequently in the literature.

(2) Curricular investigations seeking the effects of different program configurations on the development of a teaching candidate's skill are common. These investigations often address the following areas: influence of micro-teaching, (Borg, Kallenbach, Morris, Friebel, 1969; Copeland, 1977; Wagner, 1973), classroom observation feedback (Amidon, 1970; Bondi, 1970; Emmers, Good, Oakland, 1968; Ishler, 1967). Performance-based feedback (Denton, Stenning, Limbacher, 1975; Denton, Seymour, 1978).

(3) Role modeling investigations based on Bandura's social learning theory (1965, 1969) have addressed the development of alternate teaching styles among teaching candidates (Lange, 1971; Young, 1968).

(4) Time variation investigations of student teaching experiences have been reported which compare full-day-experiences for a part of the semester with half-day, full-semester experiences (Farris, 1977; Garcia, 1975).

(5) Measurement and assessment investigations have surfaced in the literature which have examined a variety of variables to determine the competence of a student teacher (Baker, 1969; Denton, Calarco, Johnson, 1977; James, 1971; Mott, 1977; Moffett, 1967; Smithman, 1970).

While the aforelisted investigations serve to document the surge of research activity in teacher education during the past decade or so, only three of these studies, i.e. Baker, (1969) Moffett, (1967) and Smithman, (1970) used learner cognitive attainment as an indicator of a student teacher's competence.

Ironically, a precedent for using learner cognitive attainment

as a measure of teaching success dates back to the scientific management era in American schools from1910 to 1930 (Callahan, 1962). Apparently, this interest continued for some time given the investigations by Rostker (1945), Rolfe (1945), and LaDuke (1945). These investigators invested substantial time and effort in collecting multiple teacher and learner variables in measuring and analyzing teaching ability based on learner achievement. Further, these investigations employed rather elaborate statistical procedures, i.e., multiple regression, to explain the effects of teacher variables on learner achievement.

During the past decade or so interest in assessing teacher performance in terms of learner achievement has re-emerged. Competency Based Teacher Education (CBTE) no doubt has been instrumental in refocusing the attention of teacher educators to assessment concerns in the preparation of teachers. Two major positions emanating from CBTE regarding assessment of teacher competency are: (1) assessment procedures which emphasize the use of classroom process criteria and (2) assessment procedures which emphasize the use of consequence criteria (learner attainment data) (Weber, 1974).

Educators favoring the use of process criteria, such as the candidates' facility with creating a favorable learning set with the class, or facility of phrasing higher order questions to determine the competence of a student teacher have concluded process data are sufficient indicators of the teaching skills of the candidate. This position is often endorsed because of the measurement difficulties and economical considerations associated with obtaining achievement gains from standardized tests (Glass, 1974; Soar, 1973).

Others who have labored with the issues of assessing teacher

competence have concluded that process criteria alone do not yield adequate evidence of teaching competence. Educators espousing this position indicate that it is necessary and feasible to use learner attainment data in the assessment of teacher competency within a teacher education context. Proponents of this position recognize the difficulties in measuring and analyzing learner growth, but contend these problems can be dealt with in ways that are cost-effective (Weber, 1974).

Perhaps an approach which integrates learner cognitive attainment data with systematic classroom observations is the optimal assessment strategy. Such a strategy has been devised by McNeil and Popham (1973, pp 233-234). These noted educational evaluators have described an alternative for assessing teacher competence which involves contract plans based on learner cognitive gain. With little or no modification, this contract plan can serve as a blueprint for assessing a student teacher's competence. The basic premise of this approach is that the objectives of the curricular plan must be agreed on before teacher competency can be assessed. Supervisors and the teaching candidate must agree on the appropriateness of stated performance objectives for the learners. Further, agreement is reached before instruction begins regarding what evidence will be used to determine whether the teaching has resulted in learner attainment of the performance objectives. Data are subsequently collected to determine whether learners have achieved the stated objectives as well as whether unintended outcomes have emerged. The evaluation plan need not exclude the use of observational systems in the assessment of instruction, rather the plan recommends their use as means for establishing descriptive records of the teaching act.

The primary advantage of the contract plan for assessing teacher competence is that it allows the student teacher in conjunction with the supervisors to establish outcomes and standards that are most appropriate for a particular group of learners. Prior learning of students, dynamics of the classroom, and classroom environment can be taken into account in establishing the instructional plan on which the student teacher is to be held accountable (McNeil, Popham, 1973).

This investigation has been fashioned to determine the influence on learner cognitive attainment of variables common to the student teaching experience. Data pertinent to these variables were obtained by implementing an assessment procedure which incorporated the tenets of the McNeil-Popham contract plan. To this end, the following research questions were developed.

1. Do expectancies of learners held by student teachers influence learner cognitive attainment on a single instructional unit when prior cognitive attainment of learners is held constant?

2. Does the amount of prior solo teaching time and opportunity to learn time provided by student teachers influence learner cognitive attainment on a single instructional unit when prior cognitive attainment of learners and expectancies of learners had by student teachers are held constant?

3. Does the planning and instructional effectiveness of the student teacher as perceived by the university supervisor affect learner cognitive attainment on a single instructional unit when prior learner cognitive attainment, expectancies of learners held by student teachers, prior solo teaching, and opportunity to learn are held constant?

4. Does a group of variables (e.g., prior cognitive attainment of learners, student teacher expectancies, planning and instructional effectiveness ratings, and measures of time on instruction) provide a model to explain a learner's cognitive attainment on a single instructional unit?

ORGANIZATION OF INVESTIGATION

Dependent-Independent Variables

The dependent variable for all four research questions is learner cognitive attainment on a single instructional unit. Numerical values for this variable represent the percentage of objectives achieved by individual learners on criterion tests referenced to objectives of a second unit developed and implemented by the student teacher. These tests are discussed in the instrumentation section of the paper.

The independent variable addressed in research question one, expectancies of learners held by student teachers, is a numerical rating from 1 (high) to 5 (low) on the cognitive abilities of a class of learners. In research question two, prior solo teaching time and opportunity to learn time serve as independent variables. These variables are measures of time allotted for instruction expressed in minutes for the initial and second units, respectively. Values for these variables were obtained by the expression $\sum_{i=1}^{n} Pi$ where n represents the number of periods in the unit and Pi represents the period length in minutes.

Planning and instructional effectiveness of the student teacher as perceived by the university supervisor are the independent variables for research question three. Cumulative numerical ratings by the university supervisor on rating scales provide the values for these two variables. These rating scales are also discussed in a subsequent section of this paper. The independent variables are then combined with learner cognitive attainment data (the percentage of objectives achieved by

individual learners on the initial unit taught by the student teacher) to form a linear model to explain learner cognitive attainment in the second unit taught by the student teacher.

Sample

A total of 629 secondary school learners and 7 student teachers provided data for this investigation. In order to qualify for student teaching, each of these candidates met the following requirements: successfully completed ninety-five semester hours (i.e. senior classification) of college work, completed at least eighteen of twenty four semester hours in two teaching fields with a minimum grade point of 2.25 on a four-point scale, and achieved a satisfactory score on an English Proficiency Examination developed and administered by the Department of English within the university. Also, candidates must have completed a minimum of ten hours of professional education with a minimum grade point of 2.50. This professional education coursework includes three hours of educational psychology, three hours of general teaching methods, and a four hour teaching field methods course.

Complete classroom sets of cognitive attainment data from the implementation of two instructional units were collected across six subject areas, i.e., chemistry (1 student teacher, 87 learners), earth science (1 student teacher, 87 learners), English (1 student teacher, 101 learners), government (2 student teachers, 143 learners), life science (1 student teacher, 104 learners), state history (1 student teacher, 107 learners). The total number of secondary level student teachers numbered 68 during the semester (Spring 1978) this investigation was conducted, with ten percent of these candidates participating in the

investigation. Reasons for the small number of student teachers in this sample range from selecting candidates assigned to a single university supervisor, thereby reducing error variance among supervisor ratings, to the sheer volume of cognitive attainment data collected from learners of the student teachers.

Program Description

This investigation was conducted under the auspices of an educational curriculum and instruction department at a Land Grant University. The teacher preparation program at this institution which participated in the investigation is a competency based program for secondary level teachers fashioned around a diagnostic prescriptive model of instruction (Armstrong, Denton, Savage, 1978). This model conceptualizes teaching as a series of events requiring five distinct sets of instructional skills, that is: Specifying Performance Objectives, Diagnosing Learners, Selecting Instructional Strategies, Interacting with Learners, and Evaluating the Effectiveness of Instruction.

The model provides a framework that encourages the development of individual teaching styles. Individualized styles are encouraged because evaluation of instruction is based on learner achievement of the performance objectives. Given this operating principle, teachers in preparation are free to choose procedures from their own repertoires that they believe will result in high levels of learner performance. Further, teacher responsibility is well served by this model. This responsibility comes not because of the teaching candidate's adherence to a set of "ideal role behaviors," but rather in adapting instructional practices, as necessary, to help learners achieve performance objectives

that have been selected.

The instructional model is introduced and skills necessary for its implementation are stressed in the general teaching methods course. Additional emphasis is directed to this model when candidates integrate the content and instructional techniques germane to their content fields into the model in the teaching field methods course. As mentioned previously, both of these courses are completed prior to student teaching. It is felt the implementation of this model is most beneficial in classrooms which use a content-centered curriculum design.

The final component in the secondary level teacher preparation program is a full semester-full day student teaching experience with twelve semester hours being awarded for successful completion of the experience. Student teachers are assigned to a classroom supervising teacher and university supervisor for the entire semester. Each student teacher is required to develop and implement two instructional units each of approximately two weeks duration. The instructional units are to include: performance objectives, a diagnostic pretest to determine whether prerequisite knowledges and skills are present, instructional strategies addressed to each performance objective, and criterion-referenced instruments. These units must be deemed acceptable and appropriate by both the classroom supervising teacher and the university supervisor prior to implementation.

The evaluation of the student teacher in this program typically consists of the supervisors completing an Evaluation Profile on the instructional competence of the student teacher, and a Curriculum Context Checklist on the instructional unit developed by the student teacher. (These instruments are described in the following section.)

In addition to these data, student teachers are required to complete a summary evaluation form for each unit taught. This self-evaluation experience is designed to emphasize the importance of program evaluation. While data from these sources were collected on all secondary teaching candidates to determine their success in student teaching, we used these data from selected student teachers in the course of this investigation.

Only one type of data was collected for this investigation which ordinarily is not collected during student teaching, namely, criterion-referenced learner attainment data. In this investigation, student teachers who participated in the investigation retained the unit tests of learners and remitted them to the university supervisor after providing feedback to the learners regarding their performance on the examinations.

Instrumentation

A variety of scales and criterion referenced instruments mentioned in the preceding section were used in obtaining measures of the various independent variables and the dependent variable in this investigation. The following paragraphs briefly describe these instruments.

An Evaluation Profile was employed to obtain the independent variable, instructional effectiveness of the student teacher as perceived by the university supervisor. A copy of this instrument is provided in Appendix A. Supervisor ratings for the items under the heading instructional competencies, (items 1-21) were summed together to provide the value for the instructional effectiveness variable. The 21 skills addressed by this instrument are consistent with the skills stressed in the methods coursework which precede student teaching. University supervisors are well versed on how these instructional competencies are presented in

the methods courses in order to complement not contradict earlier construction.

An alpha coefficient, α=.94, determined for this instrument suggests a high degree of internal consistency among responses to the various items. Further, a high degree of correspondence usually results between classroom supervisor and university supervisor ratings of a student teacher on this instrument.

A second rating scale, the Curriculum Context Checklist, was used to provide university supervisor ratings of the curricular units developed by the student teacher. Values from this scale provided data for the independent variable, planning effectiveness of the student teacher. This instrument contains a 5 choice scale identical to the scale of the evaluation profiles. Individual items of this instrument identify components of the curriculum unit e.g., general goals, focusing generalizations, concept list, diagnostic component, and directs the supervisor to rate the quality of each component. A copy of this instrument is provided in Appendix A.

Two of the independent variables addressed in this investigation, Prior Solo Teaching and Opportunity-To-Learn time, along with data for yet another independent variable, expectancies of learners held by student teachers were obtained from a Summary Evaluation of Unit form completed by the student teacher. This evaluation form, provided in Appendix A, was completed by the teaching candidate soon after completing the instruction associated with each unit. Among other items, the form required the student teacher to estimate the achievement level and socio-economic level of learners, and report the number of individuals

achieving each objective in the instructional unit. In order to complete this form, candidates had to engage in program evaluation which, in essence, was the primary function of the form.

Finally, criterion-referenced tests developed by the student teacher provided data for both an independent variable, prior cognitive attainment from Unit 1, and the dependent variable, learner cognitive attainment in Unit 2. These instruments, unique for each unit and each student teacher, represent a strength and potential limitation in the design of this investigation. As a strength, the student teacher with guidance from classroom and university supervisors developed tests related directly to the outcomes established for the performance objectives in each unit. Prior learning, extenuating classroom situations, and the abilities of the learners were taken into account in establishing both the objectives and the corresponding criterion tests. Under these conditions, the cognitive attainment measure indeed did sample the behavior called for in the performance objectives.

A potential limitation of candidate developed criterion referenced tests for this investigation stems primarily from the lack of information on the reliability and validity of the respective instruments. Conventional reliability procedures appropriate for norm referenced tests were not determined on the various criterion referenced tests because the function of these tests (to determine an examinee's level of functioning with respect to a stated criterion) is not consistent with the function of norm referenced tests (to determine an individual's performance with respect to the performance of others in the group) (Millman, 1974). Thus, while we are concerned, we are not unduly alarmed by the absence

of these values. Validity of criterion referenced instruments on the other hand can best be assessed by the logical relation of the performance objective and the individual test items. Fortunately, this analysis was conducted by the classroom and university supervisors on each candidate's test before the test was administered to the learners. Therefore, efforts were taken to assure quality control regarding the validity of these tests.

STATISTICAL DESIGN

Conceptual Regression Models

During the past decade, substantial interest has centered on the development of conceptual models for documenting the educational process. Typically these models have been constructed to explain an individual's educational achievement in terms of the following factors: individual and family characteristics, peer group influences, genetic endowments, school resources, and study attitudes (Barro, 1970, Hanushek, 1972).

One difficulty encountered with the early conceptual models for explaining educational achievement was the selection of an appropriate statistical model. Multiple regression techniques, which were relied on for similar model building in agriculture and economics, often yielded inconsistent estimates when applied to empirical data from the schools. The primary reason for these unstable estimates was determined to be the high interrelationships among educational process variables, which is known as the multicollinearity problem in statistical analysis. This problem has been resolved by specifying the educational variables as a system of simultaneous equations that lead to more accurate parameter estimates among the independent variables (Cooley and Lohnes, 1976; Murname, 1975).

This refinement of regression procedures has enabled us to develop a system of four linear structural equations to resolve the research questions for this investigation. Each structural equation takes the form of a regression model to satisfy estimation requirements. These models and a corresponding legend are presented in Figure 1.

model 1: $Y_2 = b_1Y_1 + a + E(1)$

model 2: $Y_2 = b_1Y_1 + b_2At + E(2)$

model 3: $Y_2 = b_1Y_1 + b_2At + [b_3T_1 + b_4T_2] + E(3)$

model 4: $Y_2 = b_1Y_1 + b_2At + [b_3T_1 + b_4T_2] + [b_5S_1 + b_6S_2] + E(4)$

Y_2	=	learner cognitive attainment on the second unit developed and taught by a student teacher.
Y_1	=	learner cognitive attainment on the initial unit developed and taught by a student teacher.
At	=	student teacher expectancy of learner cognitive ability.
b_{1-6}	=	least squares weight associated with the six variables.
E(i)	=	the error-of-prediction vector for model i.
T1	=	prior solo teaching time of student teacher.
T2	=	opportunity to learn time provided by student teacher.
S1	=	university supervisor quality ratings of instructional unit.
S2	=	university supervisor quality ratings of the student teacher's instructional skills.

Figure 1

Four Regression models for Examining the Competence of Student Teachers

In model 1, learner cognitive attainment on a second unit developed and implemented by a student teacher depends on the learner's prior cognitive attainment (performance on the initial unit taught by the student teacher). The effect of the instruction in the second unit is depicted by a constant, a. Inherent in this regression model is the

assumption that the effect of an instructional unit is independent of the student teacher's expectancies, her/his planning and instructional skills, and the time allowed for instruction.

Model 2 presents learner cognitive attainment on a second instructional unit taught by a student teacher as a function of the learner's prior cognitive attainment and the student teacher's expectations regarding the ability of her/his learners (At). Underlying this model is the assumption that the effect of a second instructional unit depends only on the expectancies held by the student teacher regarding the abilities of the class of learners. Justification for the inclusion of a teacher expectancy variable in this investigation rests with reviews of literature which link the influence of expectancy with the subsequent behavior of the teacher toward the learners (Good, Brophy, 1973: Paulson, 1978).

Model 3 presents learner cognitive attainment as a function of the aforementioned variables (prior attainment of learner, student teacher expectancy) and two measures of time (prior solo teaching time of the student teacher, and the opportunity to learn time). The assumption underlying Model 3 is that the effect of instruction in unit two depends on prior instructional time and the time allotted for instruction in the second unit as well as student teacher expectancy of learners. These time based variables were included in this model because of the theoretical considerations of time in the oft-cited model of school learning by John Carroll (1963). Further, recent literature on teacher effectiveness indicates time-on-task of both teacher and learner is correlated with classroom achievement. (Medley, 1977, Stallings, 1977).

Finally in model 4, learner cognitive attainment depends on the planning and instructional skills of the student teacher, as perceived by the university supervisor as well as all of the independent variables included in model 3. The assumption behind model 4 is that the effect of instruction in unit two depends on the planning and instructional skills of the student teacher, in addition to prior instructional time, opportunity to learn time and the student teacher's expectancies of learners. Supervisor ratings were included in this model because of the acceptance of this type of evaluative procedure in assessing the competence of student teachers. If supervisor ratings do accurately reflect the teaching candidate's planning and instructional skills, then these variables should account for some of the variance in learner cognitive attainment.

Statistical Analysis

These four regression models were treated with the REGRESSION subroutine in SPSS (Nie, Hull, Jenkins, Steinbrenner, Bent; 1975). The initial model (model 1) was constructed then the ensuing model, model 2 was developed by the addition of the independent variable, student - teacher expectancies, to the initial model. This procedure was repeated twice with the final model (model 4) containing six independent variables. Given this procedure, the influence of each independent variable or block of variables on learner cognitive attainment was determined by subtracting the coefficients of determination of the former model from the ensuing model, i.e., $(R^2_{i+1} - R^2_i)$. The resulting value, ΔR^2, represents the increment in explanatory power of learner cognitive attainment due to the added variable(s). Tests of significance were subsequently made for these increments of explanatory power to

statistically address the first three research questions. The expressions used for these tests are presented in figure 2.

Generalized Expression: $$F = \frac{[R^2_{i+1} - R^2_i] / M}{1 - R^2_{i+1} / N-K-L}$$

Q1: $$F = \frac{R^2_2 - R^2_1 / 1}{1 - R^2_2 / 626}$$

Q2: $$F = \frac{R^2_3 - R^2_2 / 2}{1 - R^2_3 / 624}$$

Q3: $$F = \frac{R^2_4 - R^2_3 / 2}{1 - R^2_4 / 622}$$

R^2_i = coefficient of determination for model i (variance accounted for by model i)

N = the number of learners in the model (629)

K = total number of independent variables in the model (1 to 6)

M = number of independent variables in the subset for which the F test is being made. (1 to 2)

Figure 2

Generalized Expression and Corresponding F test Expressions for Research Questions 1-3.

To test research question 1, we compared models 1 and 2. If the observations were consistent with our expectation, then the coefficient of determination or the explanatory power of model 2 should reflect a significant increase over the explanatory power of model 1 which does not take into account the influence of student teacher expectancies of learner cognitive abilities.

To test research question 2, we compared models 2 and 3. If the observations were consistent with our expectations, then the explanatory power of model 3 should provide a significant gain over the explanatory power of model 2. These models differ due to the contribution of the block of time based variables to explain learner cognitive attainment.

Finally, to test research question 3, we compared models 3 and 4.

Again, if the observations obtained were consistent with this research question, then the explanatory power of model 4 should exceed the explanatory power of model 3 due to the planning and instructional effectiveness of the student teacher.

FINDINGS

The analysis associated with research question 1 produced a F value (F=.82) which was not statistically significant. This result reveals that expectancies of learners held by student teachers do not influence the cognitive attainment of the learners, at least not in this investigation.

The statistical comparison for research question 2 produced different results. The F value for this comparison, ($F = 5.38$, $p < .01$) indicates the explanatory power (1.3 percent of the variance) of these time referenced variables is statistically significant. In other words, prior solo teaching time and opportunity to learn time together account for some differences in learner cognitive attainment on a single instructional unit when prior cognitive attainment of the learners and student teacher perceptions are held constant.

The third test compared the coefficients of determination for model 4 and model 3 for research question 3. The F value for this comparison ($F = 11.11$, $p<.01$) indicates the explanatory power (2.6 percent of the variance) of the university supervisor's ratings is statistically significant. This finding indicates the planning and instructional competencies of the student teacher as perceived by the university supervisor do affect, to some degree, learner cognitive attainment when prior cognitive attainment, student teacher expectancies, and measures of instructional time are held constant. The aforementioned statistical

comparisons for research questions 1, 2 and 3 are summarized in the following table. Additional statistical summaries are provided in Appendix B.

Table 1

Summary of Data Used to Test Research Questions 1-3

Test Legend	Research Question 1	Research Question 2	Research Question 3
N	629	629	629
K	2	4	6
M	1	2	2
R^2 from model 1	.232	--	--
R^2 from model 2	.233	.233	--
R^2 from model 3	--	.246	.246
R^2 from model 4	--	--	.272
$R^2_{i+1} - R^2_i$	.001	.013	.026
F Statistic	$F(1,626)_{.82}$	$F(2,624)_{5.38}$*	$F(2,622)_{11.11}$*

*$\alpha < .01$

Coefficients of determination (R^2) and changes in R^2 presented in table 1 provide a basis for addressing the final research question of this investigation. While the first three research questions sought to determine the explanatory power of adding a particular variable or block of variables to a linear model to account for learner cognitive attainment, research question 4 directs our attention to the cumulative effect of the variables in the respective models, (R^2 for models in table 1), to explain the variance in learner cognitive attainment. Examining table 1 reveals that model 4 accounts for maximal variance, (R^2 = .272) at least among the models in this investigation. However, this model

contains one independent variable, student teacher expectancy of learner cognitive ability, which contributes very little to the explanatory power of the model. Therefore, this variable was deleted from the model resulting in a new model with five independent variables. A statistical description of this new model is provided in table 2.

Table 2

Statistical Summary of Regression Model for Explaining a Learner's Cognitive Attainment on a Single Instructional Unit

Multiple R	.517	Analysis of Variance	Df	MS	F
R^2	.267	Regression	5	36011.43	45.44
Std. Error	28.150	Residual	623	792.43	

Variable	B	BETA	STD Error B
Y_1	.539	.505	.039
T_1	.077	.225	.020
T_2	.035	.092	.022
S_1	.784	.146	.255
S_2	.637	.071	.318
intercept - 76.011			

As table 2 reveals, the following model has a multiple R which is statistically unequal to zero, $F = 45.44$, $p<.001$, and a substantial coefficient of determination ($R^2 = .267$).

$$Y_2 = -76.011 + .539Y_1 + [.077T_1 + .035T_2] + [.784S_1 + .637S_2]$$

Symbols for the variables in this expression are identical to those for the models presented in figure 2, i.e., Y_1 = learner cognitive attainment on initial unit taught by student teacher, T_1 = prior solo teaching time of student teacher, T_2 = opportunity to learn time

provided by student teacher in the second unit, S_1 = university supervisor quality ratings of instructional unit, S_2 = university supervisor quality ratings of the student teacher's instructional skills. The numerical values in the expression are partial regression coefficients (B) and the intercept term. These values represent the expected change in learner cognitive attainment when the value of the corresponding variables changes by one unit and all other variables remain constant. The significance of this expression for determining the competence of a student teacher is addressed in the following section.

DISCUSSION

While there are alternate means and standards for determining the competence of a student teacher, we have centered on the cognitive attainment of learners instructed by the student teacher as the criterion variable in determining this competence. To some educators, this approach places the fate of teachers or in this case, student teachers, in the hands of their learners who may not be motivated or possess the pre-requisite cognitive skills to succeed. Conversely, the contract plan described by McNeil and Popham (1973) which was incorporated into the design of this investigation enables the developer to account for the entry levels and dispositions of the learners in the development of a "learning contract." This point and counter-point represent only one facet of the multifaceted process of assessing a student teacher's competence. It is beyond the scope of this paper to examine the pro's and con's of this controversy at length. Rather in this investigation, we explored the possibility of examining learner cognitive attainment in

terms of a regression model composed of variables commonly assessed during a student teaching experience.

Research question one dealt with the issue of whether the expectancies of learners held by student teachers would affect the cognitive attainment of those learners in a single instructional unit. The results of this investigation indicate the "expectancies" held by the student teacher toward the class exerted little influence on the criterion variable

It is possible that in order for expectancies of the teacher to affect learner cognitive attainment, the expectancy should be associated with a particular learner, not the class to which the learner belongs. On a positive note however, this finding supports the notion that self-awareness and control of one's expectancies of learner capability enable the student teacher to successfully control those "expectancies" during classroom instruction (Good, Brophy, 1973; Paulson, 1978). In terms of model building for assessing a learner's cognitive attainment, though, the explanatory power of this variable, as defined in this investigation, is so slight that it doesn't warrant inclusion in the model.

In contrast to the finding for research question 1, the results of the analyses for research questions two and three were statistically significant. These results encourage the inclusion of the variables examined in these analyses in the model to explain a learner's cognitive attainment.

The block of time referenced variables addressed in research question 2, prior solo teaching time and opportunity-to-learn time, accounts for a small but sufficient amount of variance regarding learner cognitive attainment to be statistically significant. This result corresponds to

the current literature on teacher effectiveness which underscores the importance of time-on-task on learner achievement (Medley, 1977; Stallings, 1977). While not specifically addressed in the literature, prior solo teaching time was included in this block of variables since the amount of previous instructional time in student teaching should affect the competence of the student teacher. This conjecture has merit if for no other reason than for the candidate gaining confidence and establishing a routine for managing the classroom during instruction. Further, data for these time based variables were obtained readily and easily from the student teacher's instructional plans and confirmed in the Summary Evaluation of Unit forms completed by the student teacher.

While the explanatory power of these variables is small, it is interesting that such global measures of instructional time account for enough variance in learner cognitive attainment to be statistically significant. Since these time measures did contribute to the explanatory power of the model, it is plausible that other time based measures such as, student teacher planning time, student teacher time-on-instruction, and learner time-on-task may be fruitful extensions of this research.

Similarly, values for the planning and instructional competence of the student teacher, the block of variables for research question 3, were readily obtained from the final evaluations of the university supervisor. Since the practice of evaluating the student teacher on the basis of supervisor ratings is so common, it is comforting to find these ratings do account for enough variance regarding the cognitive attainment of learners to be statistically significant. On the other hand, an explanatory power of 2.6% of the variance fails to inspire a great deal of confidence in university supervisor ratings as a sole criterion

for awarding a grade or certifying the teaching competence of a student teacher. Perhaps emphasis on observation data which provides frequencies of instructional procedures coupled with supervisory ratings would enhance the explanatory power of these ratings. Further, perceptional data from learners of student teachers on the instructional competence of the student teacher might be combined with supervisor ratings to enhance the explanatory power of these values. In any event, the practice of using university supervisor ratings as the only criteria for "grading" the student teacher is not supported by the results of this investigation.

The final research question directly addressed the issue of whether a group of variables closely associated with the student teaching experience may explain the cognitive attainment of learners in a single instructional unit planned and implemented by the student teacher. While the preceding discussion has accounted for the presence of four of the variables in the model, the most significant variable in the model has not been addressed. This variable, prior cognitive attainment of learners on a unit prevously taught by the student teacher, provides a contribution that is comparable to the influence of prior achievement in determining school effects (Hanushek, 1972; Murnane, 1975). This variable enabled us to hold the effect of prior instruction constant, at least statistically speaking. The resulting linear model containing five variables explained nearly 27% of the variance in cognitive attainment of learners on a single instructional unit. At first glance, this result appears to be disappointing. However, one writer recently reported that only 9 percent of the researches published in a notable professional educational research journal over the past twelve years accounted for 20% or more of the

variance regarding the dependent measure under investigation (McNamara, 1978). Thus, the practical significance of this model in explaining learner cognitive attainment appears to be relatively high when compared to current research reports.

The model which evolved from this investigation, clearly has associated learner cognitive attainment data with information collected during student teaching. However, it is wishful thinking to assume the model at this stage justifies assessing the competence of a student teacher solely in terms of learner cognitive attainment. On the positive side though, the model does provide a basis for integrating multiple sources of evaluative data and indicates empirically how these variables relate to learner cognitive attainment. Moreover, the investigation and the model in particular underscore the importance of collecting multiple sources of data on each teaching candidate. Certainly other variables not addressed in this investigation (classroom observation summaries, learner perceptions of student teacher's competence, classroom supervisor ratings, unit pretest scores) may increase the explanatory power of a regression model on learner cognitive attainment and should be considered in future researches.

Further, this investigation has demonstrated that it is feasible to implement a McNeil-Popham type of contract plan in an ongoing student teaching program. In essence, the McNeil-Popham plan becomes a management system for implementing a student teaching program which collects cognitive attainment data from learners of student teachers. This plan has great potential not only for advancing teacher preparation practices but for instructional theory building as well.

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APPENDIX A

Curriculum Context Checklist

Student teacher_____ School _____ District _____

Date _____ Classroom Supervisor _____ Univ. Sup. _____

Unit # 1 or 2 (please circle)

The rating scale for assessing the quality of each curricular component is defined as:

S = Satisfactory	U = Unsatisfactory	NA = Not Applicable
E = Excellent = 1	NI = Needs Improvement = 4	
G = Good = 2	I = Inadequate = 5	
A = Average = 3		

Curricular Component	S E	S G	S A	U NI	U I	NA
1. General goals	1	2	3	4	5	NA
2. Focusing generalizations (consistent with goals)	1	2	3	4	5	NA
3. Concept list (consistent with generalizations)	1	2	3	4	5	NA
4. Diagnostic component (addresses prerequisite knowledges and skills)	1	2	3	4	5	NA
5. Remediation strategies (provides activities and direction for those lacking prerequisites)	1	2	3	4	5	NA
6. Content outline (consistent with generalizations and concepts)	1	2	3	4	5	NA
7. Performance objectives (objectives related to goals and content generalizations)	1	2	3	4	5	NA
8. Instructional Strategies (strategy provided for each performance objective)	1	2	3	4	5	NA
9. Evaluation procedures (assessment techniques consistent with objectives and inst. strategies)	1	2	3	4	5	NA

Texas A & M University

Department of Educational Curriculum and Instruction

EVALUATION PROFILE FOR ELEMENTARY AND SECONDARY STUDENT TEACHERS

STUDENT'S NAME_____ SCHOOL_____ DISTRICT_____ DATE_____

CLASSROOM SUPERVISOR_____ UNIVERSITY SUPERVISOR_____ TIME OF OBS._____

THIS IS OBSERVATION NUMBER_____

The rating scale is defined as:

S=Satisfactory
E=Excellent - 1
G=Good - 2
A=Average - 3

U=Unsatisfactory
NI=Needs Improvement - 4
I=Inadequate - 5

NA=Not Applicable or Not Observed

OBJECTIVE*	S E 1	S G 2	S A 3	U NI 4	U I 5	NA
I. INSTRUCTIONAL COMPETENCIES						
1. Develops and uses lesson plans	1	2	3	4	5	NA
2. Develops and uses performance objectives in lesson plans and in the instructional units which satisfy the formal specifications for objectives	1	2	3	4	5	NA
3. Diagnoses, individually and as a group, students' entry level into lessons and instructional units.	1	2	3	4	5	NA
4. Interprets diagnostic data and prepares remediation plans.	1	2	3	4	5	NA
5. Demonstrates mastery of content to organize learning activities, prepare instructional materials, and develop performance objectives with regard to the subject matter field.	1	2	3	4	5	NA
6. Effectively uses duplication and material production equipment.	1	2	3	4	5	NA
7. Demonstrates skill in conducting instructional activities that use audio-visual equipment.	1	2	3	4	5	NA
8. Demonstrates the ability to use effective introductory and concluding instructional activities.	1	2	3	4	5	NA
9. Demonstrates the ability to use appropriate method(s) of instruction.	1	2	3	4	5	NA
10. Uses a minimum of four different types of stimulus variation, i.e., verbal examples, diagram on board, analogy, riddle, voice variation, gestures, facial expression, questions, in instructional activities	1	2	3	4	5	NA
11. Identifies cues associated with attending behavior of students and utilizes different stimuli to recapture student interest.	1	2	3	4	5	NA
12. Demonstrates the ability to give clear directions	1	2	3	4	5	NA
13. Demonstrates the ability to use different levels of questioning while conducting instructional activities and by writing such questions in lesson and unit plans.	1	2	3	4	5	NA
14. Uses a variety of reinforcing techinques.	1	2	3	4	5	NA
15. Demonstrates the ability to clarify values and conflicts in instructional settings.	1	2	3	4	5	NA
16. Demonstrates the ability to organize and manage classroom activities effectively and to handle or solve discipline problems occuring in the classroom by applying a variety of control techniques, i.e., simple control, individual conference, behavior modification.	1	2	3	4	5	NA
17. Constructs, administers, and interprets a variety of appropriate evaluative instruments for lesson and unit objectives.	1	2	3	4	5	NA
18. Demonstrates the ability to evaluate the effectiveness of instructional activities.	1	2	3	4	5	NA
19. Evaluates his/her own instruction (self-evaluation).	1	2	3	4	5	NA
20. Constructs and teaches two units of about two weeks duration which meet minimum criteria.	1	2	3	4	5	NA
21. Provides a good model of spoken English for students.	1	2	3	4	5	NA
II. PERSONAL AND PROFESSIONAL COMPETENCIES						
22. Consistently demonstrates a high degree of responsibility and dependability by carrying out all tasks assigned or volunteered for.	1	2	3	4	5	NA
23. Consistently arrives before scheduled classes and activities begin.	1	2	3	4	5	NA
24. Accepts and conforms to established standards of dress and personal grooming.	1	2	3	4	5	NA
25. Cooperates with supervising teacher, university supervisor, other staff members and administrative officials of the cooperating school.	1	2	3	4	5	NA
26. Accepts the presence of prevailing standards of conduct in various social groups and organizational settings, and demonstrates the ability to make personal adjustments to such standards both formal (written policies) and informal (unwritten policies).	1	2	3	4	5	NA
27. Maintains a sufficient level of energy and is free of physical disabilities which hinder teaching.	1	2	3	4	5	NA
28. Demonstrates concern for students, school, and community.	1	2	3	4	5	NA

*See pages 9-10 of the Supplement for a detailed description of each objective.

OVER

EVALUATIVE COMMENTS OBSERVATION ANALYSIS

DATE_____

Introduction of Lesson

Classroom Interaction and Teacher Movement (complete diagram of classroom, identify children, chart interaction, and teacher movement, etc.).

Development of Lesson (Note: Such things as teacher and student activity, materials used, classroom management, methods of instruction, student response, etc.)

Recommendations for Improvement

Summary or Conclusion and Evaluation

SUMMARY EVALUATION OF UNIT

For Grades 4-12

First Unit_____

Second Unit_____

Directions: This Summary Evaluation is to be completed for each of the units you are required to prepare and teach. It is to be completed as soon after you have completed the teaching and evaluation of the unit as possible and given to your university supervisor. Copies of the pre-test, posttest and grading keys are to be given to your university supervisor. You may attach these to this summary if you have not already attached them to the unit given to your university supervisor.

I. Background Information

1. Your Name_____
2. Grade level of this unit_____
3. Subject in which unit was taught (Examples: Math, Science)_____
4. Title of unit_____
5. Length of unit: a. No. of instructional periods_____
   b. Length (in minutes) in each period_____
6. Give your best estimate of the achievement level of students to which the unit was taught: High_____, Middle_____, Low_____
7. Give your best estimate of the socio-economic level of students to which the unit was taught. Upper_____, Middle_____, Lower____.

II Unit Objectives

Classify the unit objectives according to Knowledge (cognitive domain), Skills (psychomotor domain), Attitudes and Values (effective domain); give the number of objectives in each category; and the number of students achieving criterion level. (Example: obj. No. 1 is Knowledge and 23 students achieved criterion level).

KNOWLEDGE		SKILLS		ATTITUDES & VALUES	
Obj. No.	No. achieving criterion level	Obj. No.	No. achieving criterion level	Obj. No.	No. achieving criterion level

APPENDIX B

Table 3

Descriptive Statistics for the Variables Considered in This Investigation

Variable	N	X	S.D.
Learner cognitive attainment (Y_2) in unit two	629	54.85	32.75
Learner cognitive attainment (Y_1) in unit one	629	56.36	30.71
Student teacher expectancy (At) of class of learners	(28)*	1.79	.70
Prior solo teaching time (T_1)	7	630.87	95.84
Opportunity to learn time (T_2)	7	550.50	85.00
University supervisor quality (S_1) ratings of instructional unit	7	21.08	6.09
University supervisor quality (S_2) ratings of student teacher's instructional skills	7	25.02	3.66

* Each student teacher was responsible for teaching several sections of learners. The total number of class sections taught by the 7 student teachers in this investigation numbered 28.

Table 4

Statistical Summary of Regression for Model 1

Multiple R	.482	Analysis of Variance	Df	Ms	F
R^2	.232	Regression	1	156636.40	189.93
Std. Error	28.718	Residual	627	824.73	

Variable	B	BETA	STD ERROR B
Y_1	.514	.482	.037
intercept	25.868		

Simple Correlation with Y_2

Var	r
Y_1	.482

Table 5

Statistical Summary of Regress for Model 2

Multiple R	.483	Analysis of Variance	Df	Ms	F
R^2	.233	Regression	1	78592.93	95.24
Std. Error	28.726	Residual	626	825.17	

Y_1	.510	.478	.038
At	-1.400	-.029	1.715
intercept	28.59		

Simple Correlation with Y_2

Var	r
Y_1	.482
At	.099

Table 6

Statistical Summary of Regression for Model 3

Multiple R	.496	Analysis of Variance	Df	MS	F
R^2	.246	Regression	4	41496.73	50.99
Std. Error	28.526	Residual	624	813.71	

Variable	B	BETA	STD ERROR B
Y_1	.498	.467	.038
At	-.359	-.007	1.734
T_1	.039	.113	.016
T_2	-.002	-.006	.018
intercept	4.253		

Simple correlation with Y_2

Var	r
Y_1	.482
At	-.099
T_1	.177
T_2	-.101

Table 7

Statistical Summary of Regression for Model 4

Multiple R	.521	Analysis of Variance	Df	MS	F
R^2	.272	Regression	6	30516.88	38.69
Std. Error	28.086	Residual	622	788.81	

Variable	B	BETA	STD ERROR B
Y_1	.566	.530	.041
At	4.067	.084	2.070
T_1	.100	.291	.023
T_2	.053	.139	.023
S_1	1.126	.209	.308
S_2	.550	.061	.320
intercept	-113.97		

Simple correlation with Y_2

Var	r
Y_1	.482
At	-.099
T_1	.177
T_2	-.101
S_1	-.088
S_2	.086